

CLAIMS

- 1 1. A method of controlling operating characteristics of a fuel cell system, including
2 the steps of:
 - 3 (A) providing a DC-DC converter circuit having an input connection to
4 receive the output of a fuel cell and connected to place a load across that fuel cell, said
5 DC-DC converter circuit having internal switches that are operated at a duty cycle that is
6 adjustable;
 - 7 (B) providing a programmable controller that signals said DC-DC converter
8 circuit switches to adjust its duty cycle;
 - 9 (C) measuring an operating characteristic of said fuel cell to obtain an actual
10 measurement;
 - 11 (D) comparing said actual measurement to a predetermined value;
 - 12 (E) if said actual measurement does not compare as desired with the
13 predetermined value, then determining a load change needed across said fuel cell to
14 achieve the desired value; and
 - 15 (F) adjusting the duty cycle of said DC-DC converter switches to achieve that
16 load change.

- 1 2. The method as defined in claim 1 including
 - 2 (A) identifying a weakest cell in a fuel cell stack;
 - 3 (B) measuring the output voltage of the weakest cell;
 - 4 (C) comparing the actual measurement of said output voltage to a
5 predetermined minimum value;
 - 6 (D) determining the load change required to bring the minimum cell above the
7 threshold output voltage; and
 - 8 (E) adjusting the duty cycle of the DC-DC converter switches to achieve that
9 load change.

1 3. The method as defined in claim 1 including the further steps of
2 (A) measuring as said operating characteristic, the stack output voltage;
3 (B) comparing said actual measurement of said stack output voltage to a
4 predetermined minimum;
5 (C) determining the load change required to bring the stack output voltage
6 above the minimum; and
7 (D) adjusting the duty cycle of the DC-DC converter switches to achieve that
8 load change.

1 4. The method as defined in claim 1 including the further steps of
2 (A) providing at least one battery associated with the output of said DC-DC
3 converter circuit that is powered by the output voltage of the fuel cell;
4 (B) measuring as said operating characteristic, the voltage of the battery;
5 (C) determining whether said battery should be charged;
6 (D) determining a load change required across said fuel cell to produce enough
7 voltage to charge said battery to a said level; and
8 (E) adjusting the duty cycle of the DC-DC converter switches to achieve the
9 load change.

1 5. The method of controlling operating characteristics of a fuel cell as defined in
2 claim 1 including the further steps of
3 (A) measuring as said operating characteristic, the output current of a fuel cell
4 stack;
5 (B) comparing said actual measurement of the output current of the fuel cell to
6 a predetermined value; and
7 (C) adjusting the duty cycle of the DC-DC converter switches to achieve that
8 load.

1 6. The method of controlling operating characteristics of a fuel cell including the
2 further steps of
3 (A) measuring, as said operating characteristic, the output power of the fuel
4 cell stack;
5 (B) comparing said actual measurement to a predetermined maximum;
6 (C) determining a load change needed to bring the power back to the
7 maximum; and
8 (D) adjusting the duty cycle of the DC-DC converter switches to achieve that
9 load change.

1 7. A method of controlling a fuel cell system, including the steps of
2 (A) determining desired values for a plurality of operating characteristics
3 being monitored in a current mode of operation of a fuel cell system;
4 (B) measuring each of said selected operating characteristics;
5 (C) determining a duty cycle required to place the load across said fuel cell to
6 achieve each individual desired value and storing each duty cycle;
7 (D) comparing stored values and selecting the duty cycle that represents a
8 minimum load value; and
9 (E) using this duty cycle as the new duty cycle of the DC-DC converter circuit
10 switches within said fuel cell system.

1 8. The method as defined in claim 7 including the further step of
2 periodically repeating the measurements and updating the duty cycle.

1 9. A method of measuring fuel cell concentration in a fuel cell system:
2 (A) identifying the weakest fuel cell in a fuel cell stack;
3 (B) increasing the overall stack output current until the voltage of the weakest
4 fuel cell approaches zero;
5 (C) measuring the stack output current as a limiting current;

- 6 (D) determining whether concentration is too high or too low, based on the
7 measured current value; and
8 (E) dosing additional fuel or water should a predetermined value not be met.